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Case Series

Superior vena cava syndrome: presentation of 7 cases and literature review

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ABSTRACT

Superior vena cava syndrome (SVCS) is the result of obstruction of venous flow through the SVC. Mortality due to SVCS is rare (0.3%); however, the median survival in patients with SVCS secondary to malignancy is 6 months. Extrinsic occlusion due to malignancy is the most common cause; however, intraluminal thrombosis secondary to central venous catheters and pacemaker wires represents 30% of cases. The SVC is the main drainage pathway for the head, neck, and upper torso region, so SVCS is characterized by facial and neck edema, dyspnea, and distension of the neck and chest veins. Symptoms vary depending on the severity, location, and speed of onset of the obstruction and the establishment of collateral veins. Diagnosis is based on clinical presentation and imaging studies such as chest angiotomography and digital subtraction venography (gold standard). Regarding treatment, radiation therapy and chemotherapy were considered first-line; however, nowadays endovascular therapy (ET) (angioplasty, stent placement, and catheter-directed thrombus extraction) has demonstrated higher success rates and lower recurrence rates. Surgical diversion is reserved for cases of extensive venous thrombosis or occlusion not amenable to ET. We conducted a literature review and described 7 cases of SVCS treated with successful ET and their main complications at the national cancer institute of Mexico. SVCS is a condition with a diagnostic challenge. Currently, the use of endovascular treatment through angioplasty and stent placement leads to immediate improvement in patients, thus establishing it as first-line treatment.

Keywords: SVC syndrome, ET, Stent, Angioplasty balloon, Catheter-directed thrombolysis

INTRODUCTION

Superior vena cava syndrome (SVCS) is a clinical condition secondary to the obstruction of blood flow in the SVC.[1]

The main causes can be non-thrombotic, primarily malignant tumors such as non-small cell lung cancer, small cell lung cancer, and lymphoma, which represent 60% to 70% of cases and result in extrinsic occlusion of the vena cava; or thrombotic, secondary to endovascular devices such as central venous catheters, pacemaker wires, etc., which represent 30-40% of cases.[1]

Knowledge of the anatomy of the SVC is essential to understand the course and evolution of SVCS. The SVC is formed by the confluence of the right and left innominate veins and extends caudally with a length between 6 to 8 cm, draining into the right atrium.[2] Its main tributary is the azygos vein, not forgetting the right bronchial veins, mediastinal veins, esophageal veins, and pericardial veins. The anatomical classification of SVC

obstruction includes 3 levels: supra-azygos, at the level of the azygos, and infra-azygos.[2]

Clinical presentation varies depending on the severity, location, and speed of onset of obstruction and the establishment of collateral veins; the most common symptoms are: facial and neck edema and distension of the neck and chest veins, neurological and thoracic symptoms are secondary to cerebral, laryngeal, and pharyngeal edema due to elevated venous pressures from rapid SVC occlusion.[2,3]

Diagnosis is based on clinical presentation and imaging studies; chest angiotomography allows optimal visualization of the SVC, locates the length of the obstruction, differentiates thrombosis from extrinsic compression, and identifies collateral pathways, however, digital subtraction venography is the gold standard.[2,4,11]

Management of SVCS is multidisciplinary, previously based on treatment directed at the underlying cause, such as removing endovascular devices and/or administering chemotherapy or radiotherapy if the cause was malignant in order to reduce tumor burden, however, these therapies showed higher recurrence of SVCS and delayed and/or temporary symptomatic relief compared to ET [percutaneous angioplasty, stent placement, or catheter-directed thrombolysis (CDT)], for this reason, ET is currently considered first-line treatment or is associated with the aforementioned treatments. Surgical diversion is reserved for cases of extensive venous thrombosis or occlusion not amenable to ET.[3,5]

ET is less invasive and offers patients immediate symptom relief.[6] If the cause is non-thrombotic, angioplasty followed by stent placement is suggested, if it is thrombotic, consideration should be given to performing CDT associated or not with stent placement or mechanical thrombectomy if CDT is contraindicated.[6]

Complications of ET include pericardial tamponade (due to SVC rupture), SVC rupture, stent migration, in-stent restenosis, pulmonary edema, severe hemorrhage, pulmonary embolism, and cardiac injury.[7]

At our institute, the procedure technique was performed as follows (Figure 1): procedure steps: Vascular access guided by ultrasound using a wall needle and access sheath, placement of introducer, introduction of hydrophilic 0.035" guide wire with diagnostic catheter, SVC venography via diagnostic catheter to characterize stenosis, administration of heparin 2500-5000IU, navigating with hydrophilic 0.035" guide wire, passing stenosis until reaching the inferior vena cava (IVC). placement of 5 Fr diagnostic catheter. Exchange of hydrophilic 0.035" guide wire for support guide wire (Super stiff 260 cm). Placement of angioplasty catheter with balloon for dilation of the stenosis area. Venography performed to assess adequate recanalization and determine stent placement (persisting stenosis and/or collateralization), which is introduced from distal to proximal direction relative to vascular access. Post-recanalization venography conducted, observing proper contrast medium passage from the SVC to the right atrium. Removal of the guide wire and catheter. Manual compression applied at puncture site for 8-10 minutes and procedure concluded.

CASE SERIES

Case 1

A 35-year-old patient diagnosed with high-grade spindle cell neoplasm of the right arm metastatic to the lung. Presented with edema of the upper extremities, facial edema, orthopnea, and functional class II dyspnea (Kishi 4). Chest angiotomography revealed a large lung and mediastinal mass causing mass effect on the SVC along its entire length, right innominate vein, and ipsilateral jugular vein. Balloon angioplasty was performed with an 8×14 mm balloon in the SVC, followed by placement of a self-expanding bare-metal stent (Figure 1).

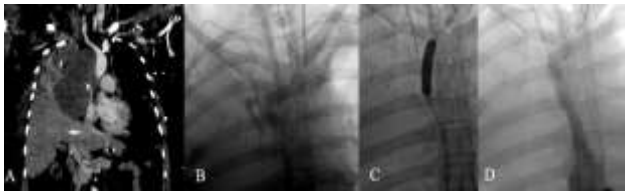

Figure 1 (A-D): Mediastinal tumor compressing the SVC, right innominate vein, and ipsilateral jugular vein.

SVC venography showing partial opacification and >90% stenosis of SVC associated with collateral vein permeabilization of right internal mammary vein. Angioplasty with 8×14 mm balloon in the area of SVC stenosis. Placement of self-expanding bare-metal stent in SVC and control venography showing flow permeability from SVC to right atrium.

Case 2

A 62-year-old patient diagnosed with stage II renal cancer, post-nephrectomy, presented with increased volume in the left neck region, facial edema, and edema of the thoracic limbs (Kishi 4). Chest contrast-enhanced computed tomography revealed mediastinal lymphadenopathy with mass effect causing obliteration of the left innominate vein, as well as >50% but <90% stenosis of the SVC, with abundant collateral circulation. Balloon angioplasty was performed with a 10 mm x 40 mm and 14 mm x 80 mm balloon, followed by placement of a 12×60 mm stent (Figure 2).

Case 3

A 36-year-old patient diagnosed with diffuse large B-cell lymphoma in the mediastinum presented with asthenia, adynamia, increased volume in the neck, orthopnea, odynophagia, facial edema, and functional class II

dyspnea (Kishi 5). Contrast-enhanced chest tomography revealed a tumor with epicenter in the anterior mediastinum causing extrinsic compression of the SVC, right brachiocephalic trunk, and stenosis of the left brachiocephalic trunk with threadlike passage, associated with significant collateral venous network, tumor implants in the right pericardial fat, partial venous thrombosis of the right jugular vein, and ipsilateral subclavian vein. Angioplasty was performed with a 12×90 mm balloon catheter in stenotic segments, followed by placement of a 100×12 mm stent (Figure 3).

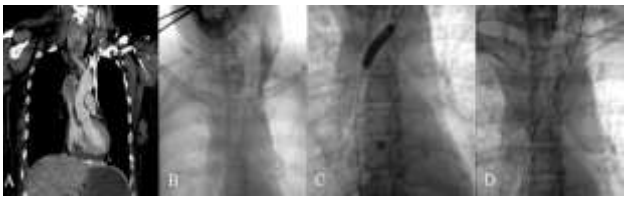

Figure 2 (A-D): Chest contrast-enhanced computed tomography reconstruction showing almost 100% occlusion of the left innominate vein and SVC.

Multipurpose guide wire introduced at the left jugular vein level, where control is performed, revealing occlusion of the left innominate vein and SVC. Balloon angioplasty performed. Placement of two self-expanding stents (Luminex) 14×80 mm in the left innominate vein and 10×40 mm in the SVC.

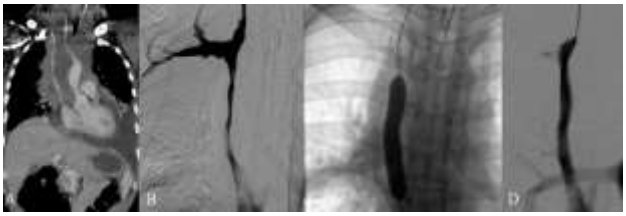

Figure 3 (A-D): Tumor in the anterior mediastinum causing extrinsic occlusion of the SVC, right brachiocephalic trunk, and stenosis of the left brachiocephalic trunk, with threadlike passage of contrast medium, associated with collateral venous network.

Control shot performed in the right jugular vein, showing a 70% reduction in the caliber of the SVC. Hydrophilic guide wire advanced to the inferior vena cava, and a self-expanding stent 12×100 mm is placed. Control cavography performed, showing proper passage of the contrast medium.

Case 4

A 64-year-old patient diagnosed with G3 gastric adenocarcinoma with signet ring cells presented with bilateral facial and eyelid edema. Contrast-enhanced chest tomography revealed >90% stenosis of the SVC with threadlike passage of the contrast medium. Angioplasty was performed with a 12×40 mm ATLAS balloon, two dilations were performed, and subsequently, a 14×60 mm stent was placed. Follow-up was conducted with chest tomography, in proper position (Figure 4).

Case 5

A 33-year-old female patient with no significant medical history, diagnosed with stage I primary mediastinal diffuse large B-cell non-Hodgkin lymphoma. Presented with facial edema, collateral venous network, chest with venous network, and bilateral edema of both thoracic limbs. Therefore, contrast-enhanced chest tomography was performed, revealing 70% occlusion of the SVC. Balloon angioplasty with a 14×80 mm balloon was performed. Subsequently, a self-expanding stent 14×80 mm was placed in SVC, followed by control venography confirming adequate permeability of the SVC (Figure 5).

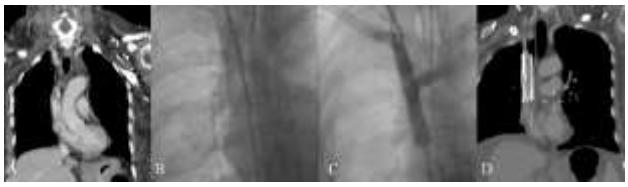

Figure 4 (A-D): Contrast-enhanced coronal chest tomography reconstruction showing 70% occlusion of the SVC.

Right jugular vein approach, with placement of a 14×60 mm stent (Venovo). Control shot showing proper opacification of the SVC. One-month follow-up tomography control, showing proper stent position with presence of a port catheter inside.

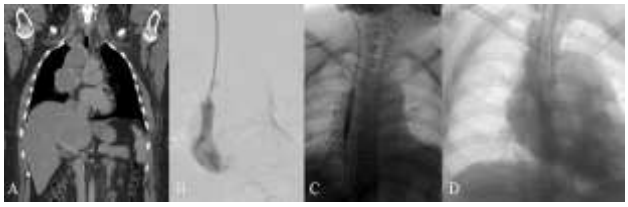

Figure 5 (A-D): Contrast-enhanced chest tomography reconstruction showing a mediastinal lymph node conglomerate that collapses the SVC almost entirely.

Venography confirming a reduction in SVC diameter of more than 90%. Angioplasty with an 8×14 mm balloon in the stenotic area. Placement of a self-expanding bare-metal stent 14×80 mm and control venography showing opacification of the SVC.

Case 6

A 72-year-old patient, with a baseline diagnosis of mediastinal tumor under investigation, presented to the emergency department complaining of functional class III dyspnea, facial edema, cervical venous distension, collateral venous network, and edema in the upper limbs (Kishi 8). A chest tomography was performed, revealing a mediastinal lymph node conglomerate causing mass effect, resulting in stenosis at the junction of the right brachiocephalic vein and SVC, accompanied by collateral circulation in the left upper limb. Angioplasty and stent placement (endoprosthesis) were performed. Initially, angioplasty with a 14×60 mm balloon was carried out, followed by a follow-up showing improvement. It was then decided to place a self-expanding bare-metal stent

14×80 mm, followed by a control venography showing adequate permeability, concluding the procedure. A tomographic control was performed at 72 hours, identifying stent thrombosis, leading to a reintervention with angioplasty and placement of a 12×60 mm stent in the SVC. Another control was performed 48 hours later, without identifying complications, and the patient was discharged due to clinical improvement (Figure 6).

Figure 6 (A-E) Contrast-enhanced chest tomography showing a mediastinal lymph node conglomerate in the anterior mediastinum causing occlusion of the SVC below the confluence of venous trunks.

Venography via the right jugular vein confirming stenosis of the SVC below the confluence of venous trunks. Angioplasty with a 14×60 mm balloon. Placement of a self-expanding stent (Luminex) 14×80 mm. Control cavography showing proper opacification of the SVC upon passage of the contrast medium.

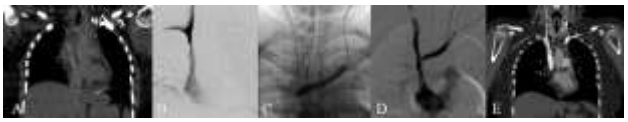

Figure 7 (A-E): Chest tomography showing a decrease in the caliber of the SVC. Venography demonstrating nearly 90% stenosis of the SVC and left brachiocephalic vein.

Angioplasty with a balloon ranging from 6 to 10×80 mm in the SVC and left innominate vein. Placement of self-expanding bare-metal stents in the SVC: 14×100 mm, and in the left innominate vein: 10×60 mm, with control venography confirming patency of flow in the SVC and left innominate vein. Three month follow-up tomography, in proper position.

Case 7

A 37-year-old female patient, without comorbidities, diagnosed with stage IV diffuse large B-cell lymphoma, during a follow-up appointment reported facial edema, distension of neck veins (Kishi score 3 points). Chest tomography showed a heterogeneous mass located in the anterior mediastinum, causing mass effect and resulting in stenosis of the left brachiocephalic vein and SVC with threadlike passage of the contrast medium. She was scheduled for angioplasty where, under ultrasound guidance, a 21 G puncture needle was advanced to the right internal jugular vein. An 8 Fr introducer was placed, and the same procedure was performed on the left side. Bilateral venography was conducted, confirming the presence of filling defect in the SVC and left brachiocephalic vein. Angioplasty was performed with 6× mm balloons. Subsequently, self-expanding bare-metal stents were placed: 14×100 mm in the SVC and 10×60 mm in the left brachiocephalic vein. Finally, control venography was performed, showing adequate opacification. The introducers were removed, and the procedure was completed without complications during or after the operation. A follow-up chest tomography was performed in 3 months showing improvement in collateral circulation (Figure 7).

DISCUSSION

The first description of SVCS dates back to 1757 by Sir William Hunter, demonstrating a complete evolution in terms of etiology. Fifty years ago, the main cause was related to infections such as syphilis and tuberculosis.[8]

Malignancy is the most common cause of SVCS in approximately 70% of cases. Currently, non-small cell lung cancer is the most common malignant tumor associated with SVCS, followed by small cell lung cancer and lymphoma. Other benign causes include thrombosis secondary to central venous catheters or permanent hemodialysis catheters, pacemakers, radiation fibrosis, etc., which represent 30% of cases.[2,8] The causes of our 7 cases were as follows: 1 case of high-grade fusocellular neoplasm, 1 case of stage II right renal cancer, 3 cases of diffuse large B-cell lymphoma, 1 case of gastric adenocarcinoma G3 with signet ring cells, and 1 case of non-Hodgkin lymphoma.

The clinical severity of SVCS has been described and quantified by Yu et al and Kishi. The scoring system proposed by these authors can be useful in diagnostic approaches and therapeutic determinations.[9,10] In our institute, the Kishi score was used to quantify the clinical severity of SVCS, with a score higher than 4 indicating percutaneous placement of SVC stent. Kishi classifies clinical signs into 4 groups: neurological signs; thoracic, pharyngeal/laryngeal signs; facial signs; and vessel dilation. In our review, all cases had a Kishi score greater than 4 prior to ET.[10]

The severity of signs and symptoms is inversely proportional to the development of collateral circulation. In SVCS, blood flow is diverted to the right atrium through the collateral venous system. There are 4 main collateral pathways: the azygos venous system, the internal mammary vein route, the lateral thoracic vein route, and the vertebral venous route. One of the most important is the azygos vein, which drains blood from the right intercostal veins and the hemiazygos vein into the SVC. The other collateral pathways include the internal thoracic route composed of the epigastric and superficial thoracic veins, the lateral thoracic route composed of the superficial circumflex iliac vein and great saphenous vein, and the vertebral and paravertebral route.[2,11]

The anatomical classification of SVCS includes three levels of obstruction: obstruction of the supra-azygos SVC, at the level of the azygos vein, and infra-azygos SVC.[2] In our review, 4 cases presented occlusion greater than 90% supra and infra-azygos, 2 cases of almost

complete supra-azygos occlusion greater than 90%, and 1 case of occlusion less than 90% supra-azygos.

Diagnosis is based on clinical presentation and imaging studies. Chest angiotomography allows optimal visualization of the SVC, locates the length of the obstruction, differentiates thrombosis from extrinsic compression, and identifies collateral pathways. It has a sensitivity and specificity of 96% and 92%, respectively. However, digital subtraction venography is the gold standard.[2,11]

There is no standardized classification system for SVCS; however, the most used methods are the Stanford and Qanadli methods, which were developed to identify the degree of obstruction in patients at risk of airway or cerebral compromise justifying surgical intervention. They classify SVCS by venography and angiotomography, respectively, into four types:[2,11] Type I: Less than 90% obstruction of the supra-azygos SVC, with permeable infra-azygos SVC and anterograde flow from the azygos vein. Type II: Almost complete (> 90%) supra-azygos SVC obstruction, with permeable azygos vein and anterograde flow. Type III: Complete (100%) SVC obstruction, with permeable and anterograde flow from the azygos vein. Type IV: Complete (100%) SVC obstruction and one or more major tributary veins, including the azygos system.[2]

Currently, there are no prospective studies of ET for SVCS. Observational data robustly suggest a success rate of 80% to 98%, with clinical improvement in 90% of patients. There is evident clinical improvement within the first 24-48 hours, with a restenosis rate of 4.3% to 29% and a recurrence rate of 1.2% to 20.5%.[2,12] The success rate in our 7 patients was 100%; however, prospective studies with a larger sample size are warranted for statistical significance.

For angioplasty and stent placement, the patient should be placed in the supine position, requiring only local anesthesia with conscious sedation and standard monitoring.[2]

Single vascular access in patients with non-occlusive lesions is usually sufficient; however, in total SVC occlusion, additional access is suggested for successful recanalization.[8]

The cephalic access to the SVC depends on the extent of SVC stenosis or occlusion, including the basilic, brachial, axillary, or internal jugular veins. In patients with total occlusion, contrast may need to be administered in both arms to identify flow direction, collateral veins, and thrombus presence.[2,7]

Balloon angioplasty alone may induce restenosis; therefore, it is preferred to combine it with stent placement (Wallstent, Palmaz stent, Z Gianturco stent). The latter may be balloon-expandable or self-expanding and may be covered or uncovered; covered stents have demonstrated greater patency at 12 months and are preferred. If the cause is non-thrombotic, angioplasty followed by stent placement is suggested; if it is thrombotic, consideration should be given to performing CDT through which a plasminogen activator (alteplase, tenecteplase, reteplase, etc.) will be infused directly into the thrombus, associated or not with stent placement or mechanical thrombectomy if CDT is contraindicated.[2,6,7]

When placing the stent, they should be placed from distal to proximal relative to the puncture site.[7]

Materials

Regarding stent selection, there is a wide variety available on the market.[2] The specific type of stent selected will be determined by its characteristics (length, diameter), as well as the experience of the interventionist. Stents are classified into two categories: self-expandable and balloon-expandable.[2] In the case of self-expandable stents, once deployed, they would assume their diameter according to their design due to their radial force. Nitinol self-expandable stents, as well as Wallstents, are flexible, easy to deploy, and highly effective in long-length stenoses. Their mesh design has the advantage of preventing tumor infiltration into the stent.[2] The main disadvantage of Wallstents is their poor radial force in longer diameters, as well as a tendency to migrate after deployment. For longer lesions extending from one venous segment to another, the use of self-expandable balloons is preferred.[2]

As for balloon-mounted stents, once positioned in the desired location, the balloon is inflated, causing the stent to expand to the desired diameter, thereby preventing the possibility of perforation.[2] They have greater radial force once inflated and lower migration potential. Among their main disadvantages is their rigidity once deployed, which may lead to stent fracture, extrinsic deformity, or reocclusion.[2] As a rule, all guidewires should be removed before stent deployment.[2] In case the procedure is prolonged, the use of 5000 IU of heparin should be administered to prevent SVC thrombosis during the procedure.[7] Finally, the choice of stent will be determined by multiple factors such as severity, length, tortuosity of the obstruction, as well as resistance to dilation.[2,7]

The main indications for SVC syndrome (SVCS) ET include patients with life-threatening symptoms, those with poor response to conventional therapy, patients for whom conventional treatments are contraindicated or have symptomatic progression, cases with thrombotic SVC obstruction, and those planned for initial chemotherapy with cisplatin.[12,13]

Absolute contraindications include irreversible coagulopathy, active infectious process, extensive thrombosis. Some relative contraindications include brain metastases, significant airway obstruction, SVCS caused

by thymoma, the latter because it may complicate future resection.[13]

Complications of ET are low and associated with the operator's experience, and can be classified as minor and major.[2,13] Minor complications represent 3.2% and include hematoma and local infection at the puncture site.[2] Major complications represent between 8% and 19% and include pericardial tamponade (due to SVC rupture), SVC rupture, stent migration, restenosis within the stent, pulmonary edema, severe bleeding, pulmonary embolism, and cardiac injury.[5] In patients with malignant SVC syndrome, stent placement carries a procedure-related mortality rate of 2%.[2,13]

The most feared complication is pericardial tamponade, which can occur secondary to perforation of the intrapericardial portion of the SVC during stent deployment.[5] One of the most common complications in SVC restenosis is due to this reason, and therefore, post-endovascular revascularization antithrombotic therapy should be considered. A short period of triple therapy may be considered in patients with thrombotic occlusion (anticoagulation, aspirin, and thienopyridine) if there is no high bleeding risk. In patients with non-thrombotic occlusion, dual antiplatelet therapy with aspirin and thienopyridine is given for one month.[5] Fagedet et al reported that when using stents >16 mm, they observed higher mortality due to increased risk of wall rupture and increased acute pulmonary edema secondary to increased venous return.[12]

The need for long-term anticoagulants after the procedure remains debatable.[12] In patients with non-thrombotic obstruction, dual antiplatelet therapy with aspirin and thienopyridine is usually administered for more than one month.[11] Most institutions recommend anticoagulants followed by stent placement.[7] In our institution, in the absence of any contraindication, we maintain our patients on antiplatelet therapy.[13]

Post-procedural surveillance includes close follow-up, usually every 3 months, with clinical assessment, chest X-ray, chest CT, Doppler ultrasound, or venography, the latter only in case of persistent symptoms.[14]

In conclusion, the main goal in the management of SVCS is symptom reduction.[14] Regarding our cases, 100% showed immediate clinical improvement (24-48 hours post-procedure) that persisted until their one-month post-ET follow-up appointments.

CONCLUSION

SVCS is a challenging condition, with high morbidity if not diagnosed early. Advances in endovascular therapy have shown better results compared to chemotherapy and radiotherapy in terms of symptomatic improvement, complications, and recurrence. However, evidence is still scarce to consider endovascular therapy as a first-line treatment for SVCS, so prospective studies should be considered to demonstrate its statistical significance.

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REFERENCES

1. Shah RP, Bolaji O, Duhan S, Ariaga AC, Keisham B, Paul T, et al. Superior Vena Cava Syndrome: An Umbrella Review. Cureus. 2023;15(7):e42227.
2. Rachapalli V, Boucher LM. Superior Vena Cava Syndrome: Role of the Interventionalist. Can Asso Radiologists J. 2014;65(2):168-76.
3. Ferraris A, Fernado J, Pollán J. Síndrome de vena cava superior: una serie de casos consecutivos en pacientes internados en un hospital terciario universitario. Revista del Hospital Italiano Buenos Aires. 2022;42(1):29-36.
4. Seligson MT, Surowiec SM. Superior Vena Cava Syndrome. PubMed. Treasure Island (FL): StatPearls Publishing. 2020.
5. Sonavane SK, Milner DM, Singh SP, Abdel Aal AK, Shahir KS, Chaturvedi A. Comprehensive Imaging Review of the Superior Vena Cava. RadioGraphics. 2015;35(7):1873-92.
6. Azizi AH, Shafi I, Shah N, Rosenfield K, Schainfeld R, Sista A, et al. Superior Vena Cava Syndrome. JACC Cardiovascular Interventions. 2020;13(24):2896-910.
7. Abrams HL, Baum S, Pentecost MJ. Abrams' angiography: interventional radiology. Philadelphia: Lippincott Williams and Wilkins. 2006.
8. Pech-Alonso B, Fermín-Hernández C, Saavedra-de Rosas SI, Cicero-Sabido RJ. Superior vena cava syndrome: Clinical considerations. Revista Médica del Hospital General Méx. 2018;81(2):59-65.
9. Radio-anatomy of the superior vena cava syndrome and therapeutic orientations. Diagnostic Interventional Imaging. 2012;93(7-8):569-77.
10. Lepper P, Ott S, Hoppe H, Schumann C, Stammberger U, Bugalho A, et al. Superior Vena Cava Syndrome in Thoracic Malignancies. Respiratory Care. 2011;56(5)653-66.
11. Yu JB, Wilson LD, Detterbeck FC. Superior Vena Cava Syndrome-A Proposed Classification System and Algorithm for Management. J Thoracic Oncol. 2008;3(8):811-4.
12. Karakhanian WK, Karakhanian WZ, Belczak SQ. Superior vena cava syndrome: endovascular management. J Vascular Brasileiro. 2019;18:e20180062

13. Calsina JL, Gil BI, Grochowicz L, Páramo Alfaro M, López-Picazo González JM, Moreno Jiménez M, et al. Endovascular treatment of malignant superior vena cava syndrome secondary to lung cancer. Hospital Pract. 2017;45(3):70-5.
14. Mauro MA, Murphy K, Thomson KR, Venbrux AC, Morgan RA. Image-guided interventions, edition 3rd. Philadelphia, Saunders. 2020.

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